HARTSTENE POINTE WATER-SEWER DISTRICT
REGULAR MEETING
DISTRICT OFFICE 119 E LIBERTY RD SHELTON WA 98584
TELECONFERENCE AVAILABLE
Per State of Emergency Declared in Washington State and Mason County
May 5, 2022 1:00 P.M.

AGENDA

1. Call to Order
2. Roll Call
3. Subscriber Remarks
4. Correspondence
5. Present Agenda
6. Minutes of the April 21, 2022 Regular Meeting **(2-3)**

BUSINESS:

7. Review & Discuss Engineering Report with Century West Engineering **(4-46)**

REPORTS:

8. Commissioner Reports
9. Financial/Administrative Report:
   - Bills to Be Authorized:
     - Voucher 2022-20
   - Bills to Be Reviewed:
     - Voucher 2022-19
10. General Manager's Report

As per the State of Emergency, the district's Open Public Meetings will be available via teleconference.

To join a meeting, follow the instructions below:
1. Call (425) 436-6260 or (800) 719-6100
2. Enter Access Code 535 9093 #

If you have a webcam-enabled computer, you may try to connect to the meeting using the link below:
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Note: Due to limited internet connection speeds at Hartstene Pointe, joining meetings via webcam may lead to reduced quality

HARTSTENE POINTE WATER-SEWER DISTRICT
REGULAR MEETING of the BOARD OF COMMISSIONERS
April 21, 2022
DISTRICT OFFICE 119 E LIBERTY RD SHELTON WA 98584
TELECONFERENCE AVAILABLE
Per State of Emergency Declared in Washington State and Mason County

MINUTES

PRESENT: President E. J. Anderson, Secretary S. Swart, Audit Commissioner A. Hospador, General Manager (GM) J. Palmer, Project & Accounts Manager (PM) J. Sartori

CALL TO ORDER: The meeting was called to order at 1:00 pm.

SUBSCRIBER REMARKS: No subscribers present

CORRESPONDENCE:

- PM noted commissioners received correspondence regarding the U.S. Census and that administrative staff will report.
- Commissioner Swart noted an upcoming workshop at HPMA regarding fire safety training.

PRESENT AGENDA: ***Commissioner Swart moved to adopt the agenda. Commissioner Hospador seconded. Hearing 3 aye votes and 0 nay votes, the agenda was adopted as presented.***

MINUTES: The minutes of the April 7, 2022 regular meeting were presented. ***Commissioner Swart moved to approve the minutes. Commissioner Hospador seconded. Hearing 3 aye votes and 0 nay votes, the minutes were approved as presented.***

REPORTS:
Commissioner Reports:

- Commissioner Swart shared promotional materials for *National Drinking Water Week*
- Commissioner Swart discussed logistics regarding the upcoming shredding event
- Commissioner Swart attended RCAC utility board training and succession planning webinar

Financial/Administrative Report:

- Bills to Be Authorized:
    - Voucher 2022-18, in the amount of $ 35,996.92, was presented. ***Commissioner Hospador moved to approve voucher 2022-18 in the amount of $ 35,996.92. Commissioner Swart seconded. Hearing 3 aye votes and 0 nay votes, the voucher was approved.***
- Bills to Be Reviewed:
    - PM presented Voucher 2022-16 for review
    - PM presented Voucher 2022-17 for review
- Monthly Billing Report: PM presented the monthly billing report for April 2022

General Manager's Report: GM presented his report on the current state of the District

BUSINESS: No Business

Commissioner Hospador moved to adjourn the meeting. Commissioner Anderson seconded. Hearing 3 aye votes and 0 nay votes, the meeting adjourned at 2:25 pm.

Respectfully Submitted By:

______________________________	Stacy Swart, Secretary, Commissioner #3
Signature	*Name and Title*

Approved at the Regular Meeting of the Board on: **5-5-2022**

PROJECT UPDATE SUMMARY

Project Status Update, May 2, 2022

PROJECT NAME (FUNDING SOURCE)	STATUS	NEXT STEPS	ACTION NEEDED
Sewer System I&I Reduction Mains	Preliminary Engineering Report (PER) complete	CWE to submit and work with USDA on funding application as directed	CWE to provide final report and work with District on scopes and funding applications
Sewer System I&I Reduction Services	Future funding through line-item appropriations or Ecology are possible	CWE to work on funding with Main I&I reduction efforts	CWE to support District with elected officials, USDA, and others
Water System Small Water System Management Plan (SWSMP)	Submitted	DOH in review	None immediately Respond to DOH comments when received
Water System Upgrades	SWSMP adoption required for DOH funding Potential DNR and line item appropriation are also options	Complete SWSMP and review funding and scope options	District/CWE to coordinate as needed

Hartstene Pointe Water/Sewer District

DRAFT

Preliminary Engineering Report

April 2022

Prepared by:

CENTURY WEST ENGINEERING

Preliminary Engineering Report

Refined Alternatives Analysis

The Hartstene Pointe Water/Sewer District is pursuing funding under the USDA-Rural Development (RD) program for a wastewater project involving refurbishment of approximately 22,300 linear feet of sewer main, 33,500 linear feet of side sewers, and relocation of 2,200 feet of threatened sewer main. As a required condition of that funding program, the District must provide a Preliminary Engineering Report (PER) meeting the requirements of USDA-RD. The following is a listing of key data points relevant to this project:

A. Total Connections: 445

B. Residential Connections: 439

C. Commercial Connections: 6

D. System ERUs

    a. Residential ERUs: 439

    b. Commercial ERUs: 6

E. Current System Flows

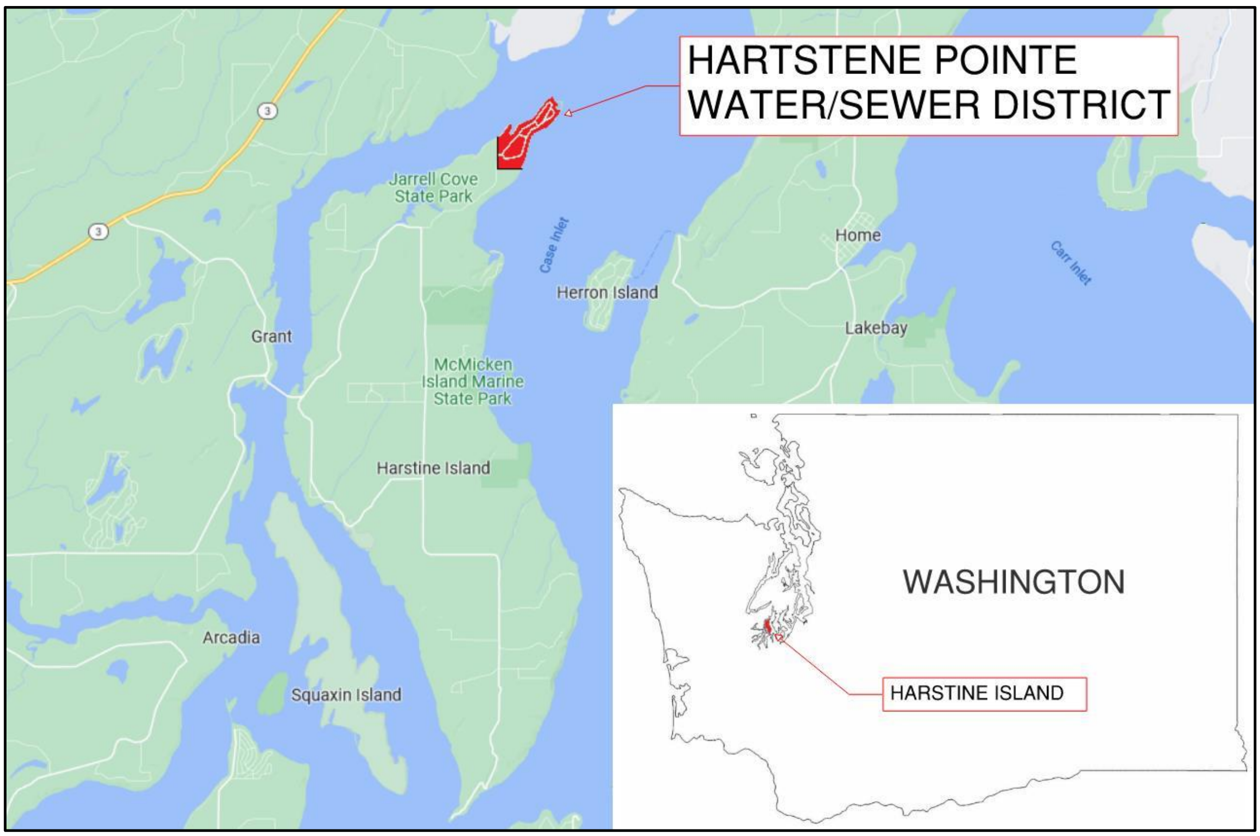
    a. Total Annual Average (over the last three years): 78,222 GPD

    b. Maximum Month (based on the last three years): 247,290 GPD

1. Project Planning

a. Location

The Hartstene Pointe community is a planned development that was originally constructed in the 1970's. It is located at the northeast end of Harstine Island in Puget Sound. The Hartstene Pointe Water/Sewer District (HPWSD) provides wastewater collection and treatment to the residential and



commercial connections within the District.

Figure 1-1. Vicinity Map

b. Environmental Resources Present

The District is within the gated Hartstene Pointe community. While individual lots are under private ownership, the lots are largely surrounded by community space owned by the Hartstene Pointe Maintenance Association (HPMA). The HPMA is a separate entity from the HPWSD. While the HPWSD owns the water distribution and sewer collection and treatment facilities, the roads are owned and maintained by the HPMA. Utility easements were platted in the roadways.

The setting of the District is relatively rural, with some degree of open space between most residential lots. The open space is heavily forested with trees and natural vegetation. The community forms a peninsula surrounded on three sides by the waters of Puget Sound. The southwest edge of the community adjoins the larger Harstine Island.

c. Population Trends

The District serves only the Hartstene Pointe community, which is a planned development. Of the 534 total lots, 445 have been built, making the system 83% built out. Infill of the remaining lots is expected to occur slowly over the 20-year planning period. No other additions to the system are anticipated.

d. Community Engagement

The District primarily engages the community through the HPMA. The board of the HPMA acts as a representative of the community members. The District also issues a monthly newsletter to district customers to keep the community aware of current events.

2. Existing Facilities

a. Location Map

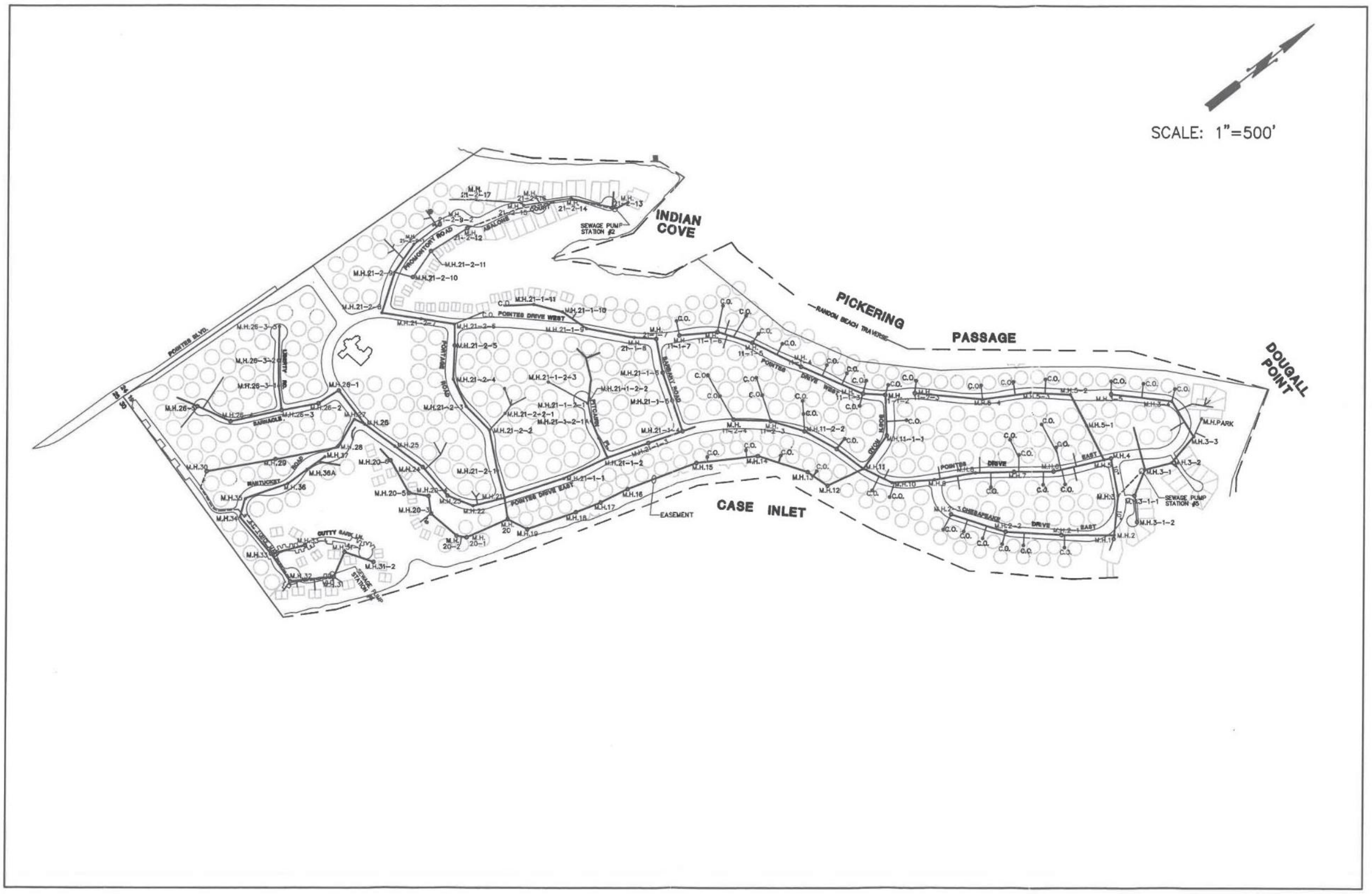


Figure 2-1. Existing Sewer System

b. History

The sewer collection system was constructed with the original Hartstene Point development between 1970 and 1973. The collection system includes 25,070 feet of gravity sewers and force mains, 113 manholes, and three lift stations. The gravity collection system consists primarily of 4-foot sections of concrete pipe with rubberized gaskets.

The collection system has a longstanding problem with excessive Inflow and Infiltration (I&I). Previous efforts have been made to isolate and define problem areas. Select repairs to the sewer system were attempted in 1990 and 1995 with limited success. In 2008, the full sewer system was inspected by remote closed-circuit TV. The TV inspection was conducted in late April and early May 2008, when I&I would be visible, but would not cause full submergence of the camera. Approximately 25,000 linear feet of sewer mains were inspected. The inspection located a total 105 problem areas that were contributing to I&I, and concluded that side sewers were a significant source of I&I as well as the sewer mains.

c. Condition of Existing Facilities

I&I continues to be a significant issue. While dry season flows average under 45,000 gallons per day (GPD), wet season monthly averages often exceed the design maximum monthly flow of 186,000 GPD. During peak wet season, I&I account for up to 80% of all wastewater flows. This excessive I&I results in poor treatment performance, reduced efficiency, and operating permit violations.

The short segment concrete pipe materials used in the original construction are very susceptible to widespread I&I. The frequent joints, brittle pipe, and 50-year old gaskets provide great opportunity for groundwater infiltration through misaligned joints, cracks in the pipe wall, and general degradation over time. Much of the pipe was poorly installed, with skewed joints to make bends rather than proper elbows. Concrete pipe was used for both the main lines and the side sewers up to the property line. The service lines past the property lines are generally PVC, and much less likely to contribute to I&I.

In addition to the I&I concerns, one segment of the primary sewer main is facing a structural risk. The sewer main between Manhole 11 and Manhole 20 provides drainage to approximately half of the District's service area. The sewer main follows topography to provide gravity flow to the WWTP. The path of the sewer main runs along the edge of a bluff above Case Inlet in Puget Sound. Over the past five decades, natural erosion has pushed the edge of the bluff back further and further to the point that this segment of sewer main is facing the threat of failure due to landslide.

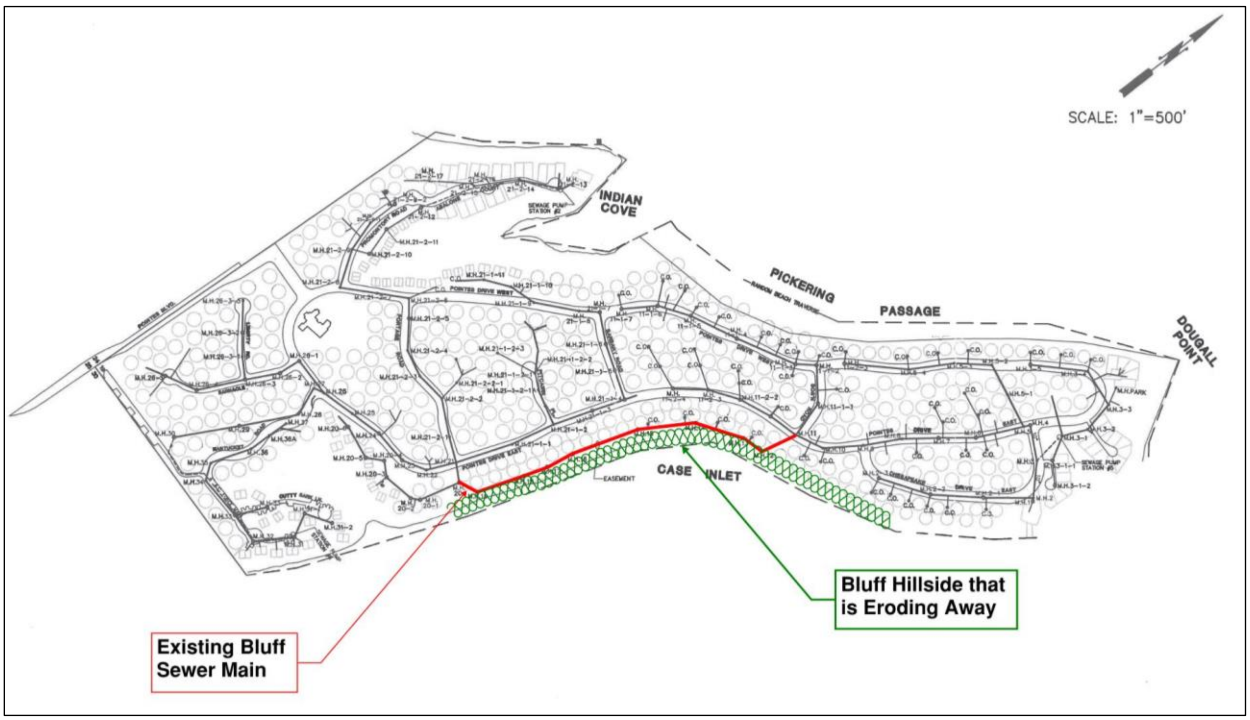


Figure 2-3: Existing Location of Bluff Sewer Main

d. Financial Status of Existing Facilities

The District charges adequate rates to fund standard operations and maintenance. The District does not have adequate reserves to self-fund a major capital improvement project.

e. Flow Rates

For purposes of design and evaluation, flow rates must be considered under various conditions. Recorded flows are summarized below, based on the last three years:

- Average Daily (Annual Avg): 77,115 GPD
- Average Dry Weather Daily: 44,271 GPD
- Maximum Month: 247,290 GPD
- Calculated Maximum I&I: 247,290 GPD – 44,271 GPD = 203,019 GPD

Based on the recorded data, average flow rates can be derived for individual service connections, also referred to as an Equivalent Residential Unit (ERU). Flow rate per ERU should not include I&I when considered as individual connections, as most I&I occurs in the District owned mains and side sewers, not at the service connections.

- Average Daily (Dry Weather): 44,271 GPD/445 ERUs = 99.5 GPD/ERU (round to 100 GPD/ERU)
- Maximum Daily: Average Daily x 2.5 Peaking Factor = 250 GPD/ERU
- Peak Hour Flow = 100 GPD/ERU x 3.8 Peaking Factor / 1440 min/day = 0.264 GPM/ERU

Overall System Peak Flow will include both the Peak Hour Flow from connections as well as the Maximum Month I&I.

- System Peak Flow = (0.264 GPM/ERU x 445 ERUs) + (203,019 GPD / 1440 Min/Day) = 258 GPM

3. Need for Project

a. Health, Sanitation, and Security

A catastrophic sewer failure due to a landslide is the greatest imminent threat to the health and security of the District. If erosion continues along the bluff, the sewer main will eventually fail as the soil around it slides away. Such a failure would release raw sewage into Puget Sound, threatening public health and aquatic resources.

b. Aging Infrastructure

The collection system has already shown excessive I&I for many years. Segmented concrete pipe with rubber gaskets is expected to have a design life of 50 – 100 years. The collection system is now over 60 years old, so joint failures and cracked pipes resulting in additional I&I are to be expected as the system continues to age. The concrete manholes throughout the system have a similar design life, and they will also allow more I&I to enter the system as the joints age and cracks form.

c. Reasonable Growth

As previously noted, the existing system is approximately 83% built out, and there is no expectation that the service area will expand. Existing facilities are adequately sized for the build-out condition, so no improvements to the system are needed to facilitate growth.

4. Alternatives Considered

SUBSECTION A: BLUFF SEWER RELOCATION

The existing sewer line segment along the Case Inlet bluff is located in soils that are progressively eroding away. It is reasonable to conclude that it is just a matter of time until the sewer line collapses as the soils that support it fall away.

There is no reasonable method to stabilize the hillside to prevent erosion caused by tide and wave action in Puget Sound. The sewer main segment must be relocated to circumvent the risk of failure. Alternatives for relocation may include gravity sewer, large lift stations, grouped grinder stations, or a combination of these, as detailed in the sections below:

4A.1 Gravity Sewer

a. Description

This alternative would abandon the existing sewer main along the bluff, and construct a new gravity sewer main at a new location to replace it. The new alignment would be within the existing easement in Pointes Drive East. An existing sewer main in Pointes Drive East would also be replaced as it currently flows to the south. The new sewer main will flow to the north from Manhole 20 to Manhole 11. Residences that are currently connected to the Bluff sewer main will be "turned around" so that they drain west towards the new sewer main rather than east. This alternative does not follow the natural topography, and so requires significant deep excavation to be feasible.

b. Design Criteria

The new gravity sewer main will convey drainage from a large area, approximately the southern half of the development. Although there is no direct measurement of the flow at this location, it is reasonable to assume that peak flow through this pipe will be half of the peak flow for the entire system.

With a calculated system peak flow of 258 GPM, the expected peak for the new sewer would be 129 GPM or 0.35 cubic feet per second (CFS). This flow rate is approximately 37% of the flow capacity for an 8-inch PVC sewer pipe laid at the minimum slope of 0.004 ft/ft. Therefore, the proposed design will use an 8-inch PVC pipe at minimum slope.

c. Map

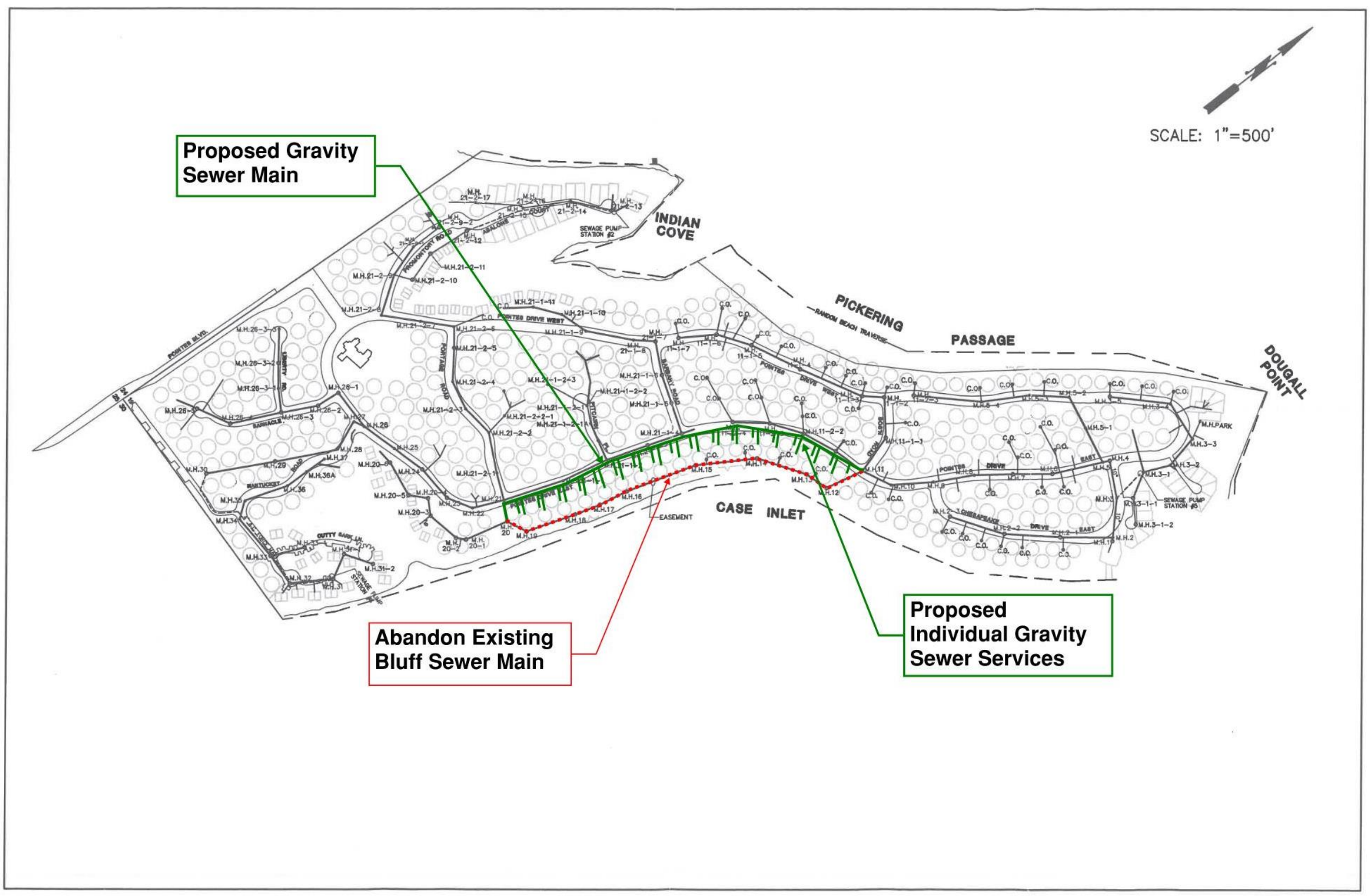


Figure 4-1: Alternative 1 Gravity Sewer

d. Environmental Impacts

The deep excavation required for this alternative will move much more soil, and disturb a larger area than other alternatives. Groundwater is likely to be encountered in the trench, so the de-watering operation will likely require settling basins and discharge of water over a large land area. Special provisions will be required to prevent erosion and damage from the water discharge.

Another concern, particularly when replacing service lines, is loss of trees. Service lines will require trenches to be excavated between houses. Much of the space between houses is heavily treed. The trench path will need to be cleared of trees to allow excavation to take place. Due to the depths required, some trees that are beyond the immediate trench path may be undermined and lost.

e. Land Requirements

The new sewer main will be placed within the existing public utility easement in Pointes Drive East, so no additional land will be needed for the main line. The service connections from each residence will also need to be redirected towards the new main. It is anticipated that most connections will be located within the public space between lots. However, the new path of each service connection, and the related land needs will need to be evaluated on a case-by-case basis.

f. Potential Construction Problems

The proposed main runs counter to the topography in that as the pipe is sloped downward, the topography is sloped upward. The result is that the sewer main requires much deeper excavation than is typical for a residential sewer main. As the proposed sewer main runs north along Pointes Drive East, from Portage Road to Barbary Road, the pipe depth will increase from 9 feet to 30 feet. Excavation at this depth requires specialty excavation equipment and extensive shoring for the trench wall. The presence of groundwater at this depth is likely, requiring additional effort for dewatering, and stabilizing saturated soils.

Excavation at this depth would require geotechnical analysis during the design phase. A series of soil borings would be completed along the route to detect the presence of solid rock in the construction zone. The analysis would also provide information for trench shoring and ground water presence.

The exact elevation and location of each service connection is unknown, and the distance to the new sewer main will be considerably longer than the distance to the existing main. Some of the service connections may not be able to achieve gravity flow to the new main. As with the main line itself, the pipe slope is counter to topography, so excavation for installation of gravity sewer services will be much deeper than typical, and will disturb large areas.

g. Sustainability Considerations

The construction process for a gravity main and gravity service lines will be more intensive than other alternatives as deep excavation, trench shoring, and dewatering are expected. However, once installed, this alternative will have the lowest energy requirements with no electrical power needed for operation.

h. Cost Estimates

Bluff Line Replacement

Alternative 1: All Gravity Sewer Main and Services

PLANNING LEVEL COST ESTIMATE

	DESCRIPTION OF ITEM	EST. QTY.	UNITS	UNIT PRICE	AMOUNT
1	Mobilization	1	LS	$164,000.00	$164,000.00
2	Clearing and Grubbing	2	AC	$25,000.00	$50,000.00
3	Trench Excavation & Backfill, 0-10 Ft Depth	480	LF	$45.00	$21,600.00
4	Trench Excavation & Backfill, 10-20 Ft Depth	1,030	LF	$105.00	$108,150.00
5	Trench Excavation & Backfill, 20-30 Ft Depth	900	LF	$180.00	$162,000.00
6	Specialty Shoring	1,930	LF	$40.00	$77,200.00
7	Pipe Bedding	2,410	LF	$12.00	$28,920.00

8	8-Inch PVC Sewer Main, D 3034, SDR 35	2,410	LF	$48.00	$115,680.00
9	Concrete Manhole, 48-Inch Diameter, 10' depth	10	EA	$6,800.00	$68,000.00
10	Concrete Manhole, 48-Inch, Additional Depth	60	VF	$250.00	$15,000.00
11	Service Line Trench Excavation & Backfill, 0-10 Ft Depth	2,140	LF	$35.00	$74,900.00
12	Service Line Trench Excavation & Backfill, 10-20 Ft Depth	1,100	LF	$60.00	$66,000.00
13	Service Line Trench Excavation & Backfill, 20-30 Ft Depth	900	LF	$80.00	$72,000.00
14	Service Line Bedding	4,140	LF	$4.00	$16,560.00
15	4-Inch PVC Sewer Service Pipe	4,140	LF	$6.00	$24,840.00
16	Asphalt Repair, 3-Inch Depth, 22-Foot width	5,900	SY	$45.00	$265,500.00
17	Crushed Surfacing Top Course, 4-Inch Depth	655	CY	$105.00	$68,775.00
18	Surface Restoration, Hydroseed	2	AC	$11,000.00	$22,000.00
19	Slope Protection Blanket	400	SY	$10.00	$4,000.00
20	Traffic Control	40	DAY	$1,500.00	$60,000.00
21	Trench Dewatering	75	DAY	$3,000.00	$225,000.00
22	Temporary Sewage Bypass Pumping	25	DAY	$2,500.00	$62,500.00
23	Spill Prevention, Control, and Countermeasures	1	LS	$20,000.00	$20,000.00
24	Existing Sewer Line Abandonment (Grout Fill)	2,200	LF	$5.00	$11,000.00
					$0.00
				CONSTRUCTION TOTAL	**$1,803,625.00**
				CONSTRUCTION CONTINGENCY, 25%	**$451,000.00**
				SALES TAX 8.5%	**$191,643.13**
				ENGINEERING DESIGN	**$293,200.00**
				CONSTRUCTION MANAGEMENT & INSPECTION	**$270,600.00**
				TOTAL ESTIMATED CAPITAL COST	**$3,011,000.00**

i. O&M Costs

Gravity sewer mains have very low operation & maintenance (O&M) costs. No electrical power is needed for water to flow downhill, and there are no mechanical parts to maintain. It is assumed a nominal amount of time will be spent inspecting and maintaining the lines, totaling 40 man-hours, or $1,000.00 per year.

4A.2 Community Lift Station with Grouped Grinder Pumps

a. Description

This alternative would abandon the existing gravity sewer main along the bluff, and would replace it with a new Community Lift Station at Manhole 20, near the intersection of Pointes Drive East and Portage Road. The new lift station would collect from all services to the west and south of the intersection, and would pump to Manhole 11-2-4, which is on Pointes Drive East, just north of Barbary Road. Small grinder pump lift stations would be installed for the service connections that currently drain into the bluff sewer main. These grinder lift stations would be placed so that between one and four residences would drain into each grinder station. There are 35 lots that would need to be served by grinder pump stations, although not all of the lots are occupied or built upon. For evaluation purposes, it is assumed that 12 grinder stations will be required to serve these lots, with an average of 3 lots per grinder station. These stations would pump to the existing gravity main in Pointes Drive East.

b. Design Criteria

The community lift station would be sized to provide service for the approximately 353 existing and future services that would drain to it. The pumps would also need to handle the peak I&I coming from that drainage area. The lift station must be equipped with two pumps for redundancy. Each pump is sized to discharge the peak hour residential flow of 93.2 GPM plus I&I loading of 93 GPM, for a total inflow of 186.2 GPM. The pumps will be sized to discharge 200 GPM to ensure adequate capacity. The pumps will operate in an alternating lead-lag configuration, so that the lead pump will alternate at each pump cycle. Only the lead pump will run during a normal cycle. In the event of a lead pump failure, or unusually high flow rate, the lag pump will also turn on until the pump cycle is complete. The wet well is sized to provide minimum submergence, working volume, and storage volume.

i) Minimum submergence is the volume required to keep submersible pumps submerged. This is necessary to provide adequate cooling of the motors and ensure long performance life. A minimum water level is also needed to prevent a surface vortex from forming, as that could negatively effect pump performance. A water depth that meets minimum submergence is more than adequate to prevent vortex formation. The pumps have a height of approximately three (3) feet, which will be the minimum submergence depth. For a wet well with a standard 8-foot diameter, the minimum submergence volume is 1,127 gallons.

ii) Working Volume is the volume between the ON switch and Off switch for pump operation. The minimum working volume can be calculated from the formula in section C2-1.2.5 of Ecology's Criteria for Sewage Works Design (CSWD): V=tQ/4, where t is the minimum time between pump starts and Q is the pump capacity in GPM. To limit pump cycling to a maximum of 4 starts per hour, t=15 minutes, and Q=200 GPM as previously stated. The Working Volume is then V=(15 Min)(200 GPM)/4= 750 gallons. For an 8-foot diameter wet well, this volume requires a depth of 2.0 feet.

iii) Storage Volume is the volume required to store 24 hours of flow in the event of a power outage. Due to the high flows entering this lift station, 24 hours of storage would exceed 170,000 gallons, making on-site emergency storage impossible. Instead, an on-site standby generator will be required, so that the lift station will continue operating during a power outage. The wet well should include a small amount of Storage Volume to allow the generator several minutes to start up and make the transition to standby power. Five minutes worth of storage at the peak hour flow of 190 GPM requires a volume of 950 gallons, equivalent to a depth of 2.53 feet.

iv) The dimensions of the lift station are also dependent on the depth of the gravity sewer main that drains into the wet well. If placed adjacent to MH 20, the sewer is approximately 7.5

feet below the ground surface. The depth for gravity sewer invert, plus depths for minimum coverage, operational volume, and storage volume result in a minimum depth of 15.03 feet. (7.5 + 3 + 2 + 2.53 = 15.03). For flexibility in design, and to allow freeboard above the ground surface, the wet well will be sized for a 16 foot depth, which is a standard dimension.

The grouped grinder pump stations would be sized based on the number of connections served. The Peak Design Flow is taken from CSWD section C1-10.1.2, with the equation is Q=15+(.5)D, where Q is the peak flow in GPM, and D is the number of dwellings served. For grinder pumps that serve one, two, three or four connections, the peak design flows are 15.5 GPM, 16.0 GPM, 16.5 GPM, and 17 GPM, respectively. The required volume of the grinder pump station is the sum of the Detention Volume, Working Volume, and Storage Volume.

i) The Detention Volume is calculated as V_d=1.5Q, where V_d is the volume in gallons and Q is the peak day flow for the connection(s) served. For three residential connections, V_d =1.5(250 GPD)(3) which is 1,125 Gallons.
ii) Working Volume is the volume between the ON switch and Off switch for pump operation. To limit pump cycling to a maximum of 4 starts per hour, the Working Volume must be a minimum of 62 gallons, where V=(15 Min)(16.5 GPM)/4= 62 gallons.
iii) Storage Volume is the volume required to store 24 hours of flow in the event of a power outage. This volume is based on average daily flow per ERU, V_s=(No of ERUs)(ADF/ERU). For three ERUs with an average flow rate of 100 GPD, V_s=(3)(100 GPD/ERU) for a total Storage Volume requirement of 300 Gallons.
iv) The sum of the Detention Volume, Working Volume, and Storage Volume for a grinder station serving three residences is 1,125 Gal + 62 Gal + 300 Gal = 1,487 Gallons. For constructability, the volume will be rounded to 1,500 Gallons, which is a common size for manufactured septic vessels.

Storage Type	1 Connection	2 Connections	3 Connections	4 Connections
Detention Volume	375	750	1,125	1,500
Working Volume	58	60	62	64
Storage Volume	100	200	300	400
Total Volume (Gallons)	533	1,010	1,487	1,964

c. Map

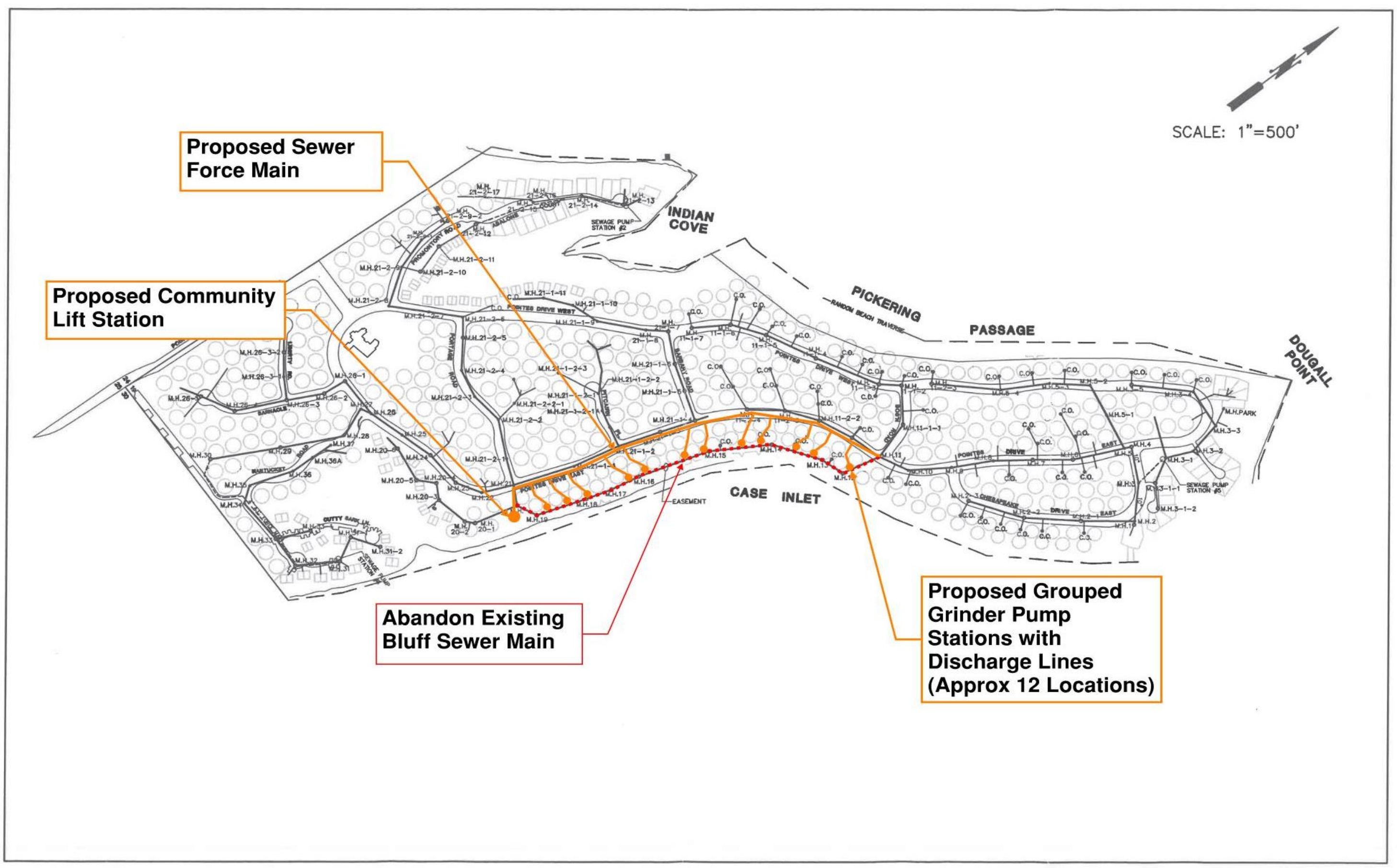


Figure 4-2: Community Lift Station with Grouped Grinder Pumps

d. Environmental Impacts

The community lift station and force main will be located along an existing roadway. Excavation for the lift station will be confined to the immediate site. Excavation for the force main will be relatively shallow at approximately 4 feet deep. No significant environmental impacts are expected.

Installation of the grinder pump stations will require excavation for the station itself, as well as the gravity lines draining to the station and the pressure lines going to Pointes Drive East. Excavation for the pressure lines will be much shallower than gravity lines, as they can follow the ground topography. This will require less ground disturbance, and fewer trees affected than a gravity sewer alternative.

e. Land Requirements

The community lift station would be located adjacent to Manhole 20 in the existing right-of-way. The force main would follow along Pointes Drive East to the discharge location at Manhole 11-2-4. All of the community lift station components would be within existing right-of-way, so no new land acquisition would be required.

The grinder pump stations will be located in the common area between residential lots. The pressure lines from the grinder stations will also run in the common area between lots.

f. Potential Construction Problems

Due to topography, vegetation, and existing structures, finding a suitable location for multiple grinder pump stations may be difficult. The particular location of each grinder pump will have to be determined in the field to accommodate field conditions and the service lines from each residence.

Bringing electrical power in for each grinder pump station will require multiple new electrical service drops and meters.

g. Sustainability Considerations

This alternative includes both a community lift station and multiple grinder pump stations. All of these pumps utilize electrical power to convey wastewater, so there is a higher energy use than a gravity only system.

h. Cost Estimates

Bluff Line Replacement

Alternative 2: Community Lift Station and Grouped Grinder Pumps

PLANNING LEVEL COST ESTIMATE

	DESCRIPTION OF ITEM	EST. QTY.	UNITS	UNIT PRICE	AMOUNT
1	Mobilization	1	LS	$103,000.00	$103,000.00
2	Clearing and Grubbing	1	AC	$25,000.00	$25,000.00
3	Trench Excavation & Backfill, 4 Ft Depth	1,660	LF	$30.00	$49,800.00
4	Pipe Bedding	1,660	LF	$10.00	$16,600.00
5	6-Inch HDPE Pressure Sewer	1,660	LF	$35.00	$58,100.00
6	Wastewater Lift Station, Duplex 7.5 Hp Pumps	1	EA	$200,000.00	$200,000.00
7	Standby Power Generator, 30kW	1	EA	$45,000.00	$45,000.00
8	Pressure Sewer Cleanout	3	EA	$3,500.00	$10,500.00
9	Service Line Trench Excavation & Backfill, 4 Ft Depth	2,400	LF	$15.00	$36,000.00
10	2-Inch HDPE Pressure Sewer	2,400	LF	$10.00	$24,000.00
11	Grinder Pump Station, Duplex Pumps	12	EA	$25,000.00	$300,000.00
12	Asphalt Repair, 3-Inch Depth, 10-Foot width	2,700	SY	$45.00	$121,500.00
13	Crushed Surfacing Top Course, 4-Inch Depth	300	CY	$105.00	$31,500.00
14	Surface Restoration, Hydroseed	1	AC	$11,000.00	$11,000.00
15	Slope Protection Blanket	200	SY	$10.00	$2,000.00
16	Traffic Control	20	DAY	$1,500.00	$30,000.00
17	Trench Dewatering	0	DAY	$3,000.00	$0.00
18	Temporary Sewage Bypass Pumping	0	DAY	$2,500.00	$0.00
19	Spill Prevention, Control, and Countermeasures	1	LS	$20,000.00	$20,000.00
20	Existing Sewer Line Abandonment (Grout Fill)	2,200	LF	$5.00	$11,000.00
					$0.00
				CONSTRUCTION TOTAL	**$1,095,000.00**
				CONSTRUCTION CONTINGENCY, 25%	**$273,800.00**
				SALES TAX 8.5%	**$116,348.00**
				ENGINEERING DESIGN	**$246,400.00**
				CONSTRUCTION MANAGEMENT & INSPECTION	**$164,300.00**
				TOTAL ESTIMATED CAPITAL COST	**$1,896,000.00**

i. O&M Costs

This alternative uses a lift station and multiple grinder pumps that have an electrical operating cost. Each of these components also require occasional inspection and maintenance, as well as periodic replacement. The anticipated annual expenses are detailed below.

ANNUAL O&M COST ESTIMATE

	DESCRIPTION OF ITEM	QTY.	UNITS	PRICE	AMOUNT
1	Operator Labor, (Lift Station Monthly Inspection)	12	ManHr	$25.00	$300.00
2	Pump Electrical Cost, 11.2 kW, 5 hrs/day, 12 mo.	20,160	kW-Hr	$0.074	$1,491.84
3	Pump Replacement, 1 Pump every 5 Years	0.2	EA	$6,500.00	$1,300.00
4	Standby Power Generator Maintenance	12	Month	$100.00	$1,200.00
5	Operator Labor, (Grinder Pump Monthly Inspection)	144	ManHr	$25.00	$3,600.00
6	Grinder Pump Elect Cost, 2.3 kW, 2 hrs/day, 12 mo, x12	20,000	kW-Hr	$0.074	$1,480.00
7	Grinder Pump Replacement, 1 Pump every Year	1.0	EA	$2,500.00	$2,500.00
				ANNUAL O&M TOTAL	**$11,900.00**

4A.3 Gravity Sewer Main with Grouped Grinder Pumps

a. Description

This alternative combines components of two previous alternatives. In this alternative, the gravity sewer main along the bluff will be abandoned with a new gravity sewer main constructed in Pointes Drive East. The new sewer main will flow to the north from Manhole 20 to Manhole 11, and would include replacing the existing main in Pointes Drive East.

The individual services that currently drain to the bluff sewer main, would be redirected to drain to grinder pump stations that would serve an average of three lots each. The grinder pumps would discharge to the gravity main in Pointes Drive East.

b. Design Criteria

The gravity sewer main is sized to serve approximately 353 existing and future services that would drain to it, as well as peak I&I, for a design flow rate of 186 GPM, or 0.498 CFS. This is well within the capacity of an 8-inch PVC sewer pipe laid at the minimum slope of 0.004 ft/ft. Therefore, the proposed design will use an 8-inch PVC pipe at minimum slope.

The grinder pumps will be sized based on the number of connections each one serves. Each is expected to serve between one and four connections. The volume is based on the sum of the Detention Volume, Working Volume, and Storage Volume, as detailed above. For evaluation purposes, it is assumed that 12 grinder stations will be required to serve these lots, with an average of 3 lots per grinder station. This would require a 1,500 gallon grinder station with a 16.5 GPM pump.

This alternative differs from Alternative 1 by using grouped grinder stations instead of laying new gravity service connections. This significantly reduces the deep excavation in the common area between houses, and all the surface disturbance, tree loss, and environmental impacts that goes along with deep excavation.

c. **Map**

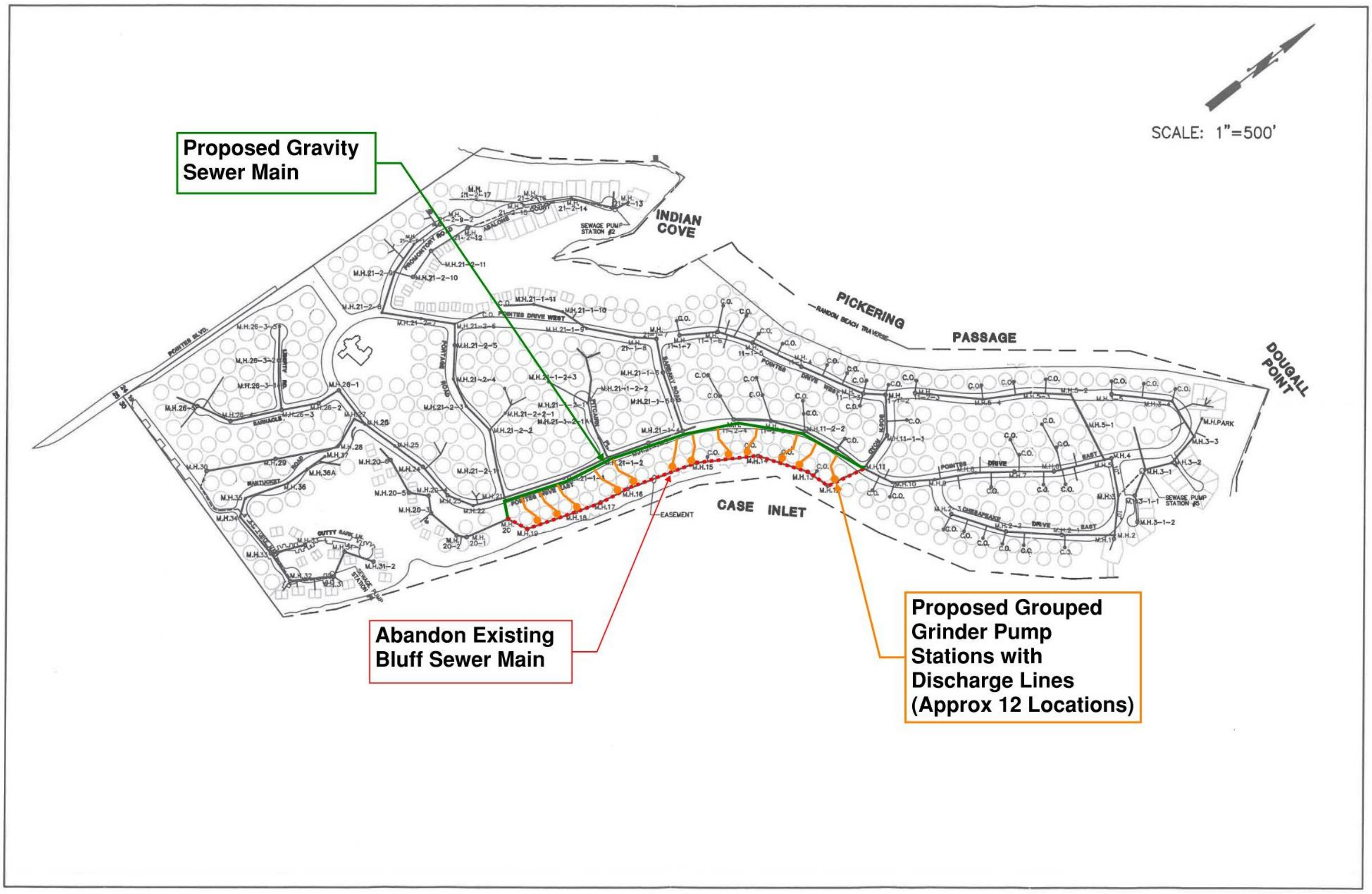


Figure 4-3: Alternative 3 Gravity Sewer with Grouped Grinder Pumps

d. **Environmental Impacts**

The deep excavation required for the gravity sewer main will move much more soil, and disturb a larger area than the community lift station alternative. Groundwater is likely to be encountered in the trench, so the de-watering operation will likely require settling basins and discharge of water over a large land area. Special provisions will be required to prevent erosion and damage from the water discharge.

Excavation for the grinder stations and discharge piping is relatively shallow as compared to gravity drain lines, and so the grouped grinder stations will have minimal environmental impact.

e. <u>Land Requirements</u>

The new sewer main will be placed within the existing public utility easement in Pointes Drive East, so no additional land will be needed for the main line. The grinder pump stations will be located in the common area between residential lots. The pressure lines from the grinder stations will also run in the common area between lots. So no new land acquisition would be required.

f. <u>Potential Construction Problems</u>

The proposed main runs counter to the topography in that as the pipe is sloped downward, the topography is sloped upward. So the sewer main will have deep excavation increasing from 9 feet to 30 feet. Excavation at this depth requires specialty excavation equipment and extensive shoring for the trench wall. The presence of groundwater at this depth is likely, requiring additional effort for dewatering, and stabilizing saturated soils.

Finding a suitable location for each of 12 grinder pump stations may be difficult. The particular location of each grinder pump will have to be determined in the field to accommodate local conditions and the service lines from each residence. Each site will also require electrical service drops and meters.

g. <u>Sustainability Considerations</u>

A gravity sewer main is the most efficient way to convey wastewater, as no electrical power is required. The grinder pumps serving groups of residences will require power, and so are less efficient than an all-gravity system.

h. Cost Estimates

Bluff Line Replacement

Alternative 3: Gravity Sewer Main with Grinder Pump Stations

PLANNING LEVEL COST ESTIMATE

	DESCRIPTION OF ITEM	EST. QTY.	UNITS	UNIT PRICE	AMOUNT
1	Mobilization	1	LS	$162,000.00	$162,000.00
2	Clearing and Grubbing	2	AC	$25,000.00	$50,000.00
3	Trench Excavation & Backfill, 0-10 Ft Depth	480	LF	$45.00	$21,600.00
4	Trench Excavation & Backfill, 10-20 Ft Depth	1,030	LF	$105.00	$108,150.00
5	Trench Excavation & Backfill, 20-30 Ft Depth	900	LF	$180.00	$162,000.00
6	Specialty Shoring	1,930	LF	$40.00	$77,200.00
7	Pipe Bedding	2,410	LF	$12.00	$28,920.00
8	8-Inch PVC Sewer Main, D 3034, SDR 35	2,410	LF	$48.00	$115,680.00
9	Concrete Manhole, 48-Inch Diameter, 10' depth	10	EA	$6,800.00	$68,000.00
10	Concrete Manhole, 48-Inch, Additional Depth	60	VF	$250.00	$15,000.00
11	Service Line Trench Excavation & Backfill, 4 Ft Depth	2,400	LF	$25.00	$60,000.00
12	2-Inch HDPE Pressure Sewer	2,400	LF	$10.00	$24,000.00
13	Grinder Pump Station, Duplex Pumps	12	EA	$25,000.00	$300,000.00
16	Asphalt Repair, 3-Inch Depth, 22-Foot width	5,900	SY	$45.00	$265,500.00
17	Crushed Surfacing Top Course, 4-Inch Depth	655	CY	$105.00	$68,775.00
18	Surface Restoration, Hydroseed	2	AC	$11,000.00	$22,000.00
19	Slope Protection Blanket	400	SY	$10.00	$4,000.00
20	Traffic Control	40	DAY	$1,500.00	$60,000.00
21	Trench Dewatering	25	DAY	$3,000.00	$75,000.00
22	Temporary Sewage Bypass Pumping	25	DAY	$2,500.00	$62,500.00
23	Spill Prevention, Control, and Countermeasures	1	LS	$20,000.00	$20,000.00
24	Existing Sewer Line Abandonment (Grout Fill)	2,200	LF	$5.00	$11,000.00
					$0.00
				CONSTRUCTION TOTAL	**$1,781,325.00**
				CONSTRUCTION CONTINGENCY, 25%	**$445,400.00**
				SALES TAX 8.5%	**$189,271.63**
				ENGINEERING DESIGN	**$289,500.00**
				CONSTRUCTION MANAGEMENT & INSPECTION	**$267,300.00**
				TOTAL ESTIMATED CAPITAL COST	**$2,973,000.00**

i. O&M Costs

This alternative uses a gravity sewer main line, but also uses multiple grinder pumps for the service connections, which have an electrical operating cost. The gravity sewer main has minimal O&M requirements, while the grinder pumps have components that require occasional inspection and maintenance, as well as periodic replacement. The anticipated annual expenses are detailed below.

ANNUAL O&M COST ESTIMATE

	DESCRIPTION OF ITEM	QTY.	UNITS	PRICE	AMOUNT
1	Operator Labor, (Gravity Sewer Bi-Annual Inspection)	40	ManHr	$25.00	$1,000.00
2	Operator Labor, (Grinder Pump Monthly Inspection)	144	ManHr	$25.00	$3,600.00
3	Grinder Pump Elect Cost, 2.3 kW, 2 hrs/day, 12 mo, x12	20,000	kW-Hr	$0.074	$1,480.00
4	Grinder Pump Replacement, 1 Pump every Year	1.0	EA	$2,500.00	$2,500.00
				ANNUAL O&M TOTAL	**$8,600.00**

SUBSECTION B: EXCESS I&I

Excessive I&I is causing problems with treatment capacity and effectiveness, as described and documented above. Addressing the issue requires widespread repair of the collection piping, including both the mains and District-owned side sewers. There are four potential methods to achieve this. These methods are investigated and analyzed in the following sections based on feasibility, outcome, and capital cost.

4B.1 Alternative 1 – No Action

a. Description

The first alternative considered is a no action option. The feasibility of this option is straight forward and simple as it would require no effort or cost on the part of the District in the short term. Future failures and discovered leaks of the sewer pipe could be addressed by point repairs. The known problem areas already exceed the financial and workforce capacity of District staff to keep up with repairs. The frequency and size of pipe failures and leaks will increase as the system continues to age and degrade.

b. Design Criteria

None.

c. Map

None.

d. Environmental Impacts

Excessive I&I results in poor treatment performance, which has been an ongoing problem with the District. Poor treatment directly affects the environmental health of Puget Sound, and nearby beneficial uses. Additionally, leaks and failures of sewer mains could lead to a direct discharge of raw sewage to Puget Sound, which would require an Emergency Spill Response by the Department of Ecology. As it is, the District incurs permit violations on a regular basis due to excess I&I.

e. Land Requirements

None.

f. Potential Construction Problems

While the No Action alternative doesn't have planned construction activities, emergency repairs will be needed on an increased basis. Main breaks could or would likely occur at unanticipated time frames and in locations that may not be identified until a sink hole developed in a roadway or shoulder surface. By that time the need to execute a repair would be imminent, costly, and difficult.

g. Sustainability Considerations

Performing No Action will allow the excessive I&I to continue, and likely increase as the pipes and joints continue to deteriorate. As a result, excessive cost and energy is required to treat the additional flow, and the treatment of wastewater is less effective.

h. Cost Estimates

While this alternative has the lowest cost and least effort in the short-term, it does nothing to correct the detrimental effects of I&I. As noted above, point repairs when they occur would require immediate attention which, if self-performed, would be difficult to achieve and if performed by a contractor would be done under high cost no bid scenarios leading to overtime, high materials, and excessive equipment costs. The long term costs of treating excessive flows, as well as continued and increasing costs of point repairs will eventually outweigh the short-term savings. Repeated permit violations may also result in fines from Ecology that can quickly exceed the cost of repairs.

No cost estimate can adequately be prepared for this option as the exact timing, cost, and required scope of repairs cannot be reasonably estimated.

4B.2 Alternative 2 – Open Trench

a. Description

The most conventional method of addressing the excessive I&I situation would be to replace the existing gravity sewer mains, manholes, and side sewers with new PVC pipe and manholes with gasketed joints. Along the identified segments, the existing sewer mains will be dug up using standard open-trench construction methods. New PVC pipe will be laid alongside the old pipe, along with new manholes. Side sewers (service connections) will be replaced up to the property line of the residence. Open trench replacement would leave the District with a long lasting sewer main and would provide a highly resilient solution but is a much more invasive approach compared to other alternatives.

b. Design Criteria

This alternative replaces existing concrete gravity sewer pipe with ASTM D3034 PVC pipe. Manholes will be replaced with precast concrete units that use watertight gaskets to prevent groundwater entry. The size and slope of pipes will match the exiting pipes, and will have the same capacity.

c. Map

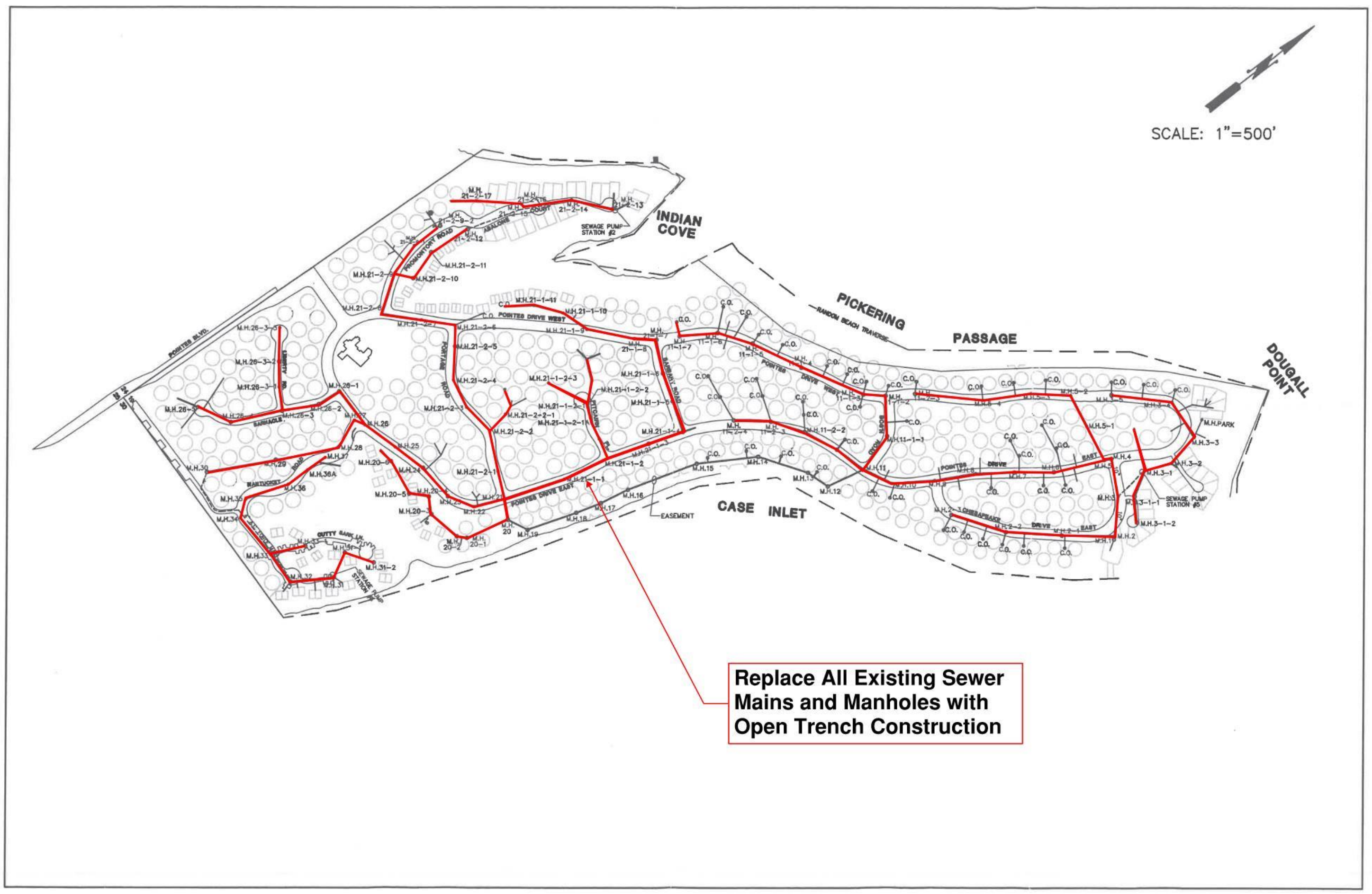


Figure 4-4: Alternative 2 Open Trench Gravity Sewer Replacement

d. Environmental Impacts

This alternative requires extensive excavation and large-scale disruption of the ground surface. As with other conventional excavation projects, the environmental impacts would be temporary, but this alternative has a longer construction schedule, and disrupts much more surface area than the other alternatives.

e. Land Requirements

This alternative follows along the existing pipeline in existing rights-of-way and easements, so no land acquisition is needed.

f. Potential Construction Problems

Open trench replacement adds a host of issues to the project including utility relocations, roadway interruptions, and repairs, and sewer service interruptions. The corridor through which this sewer main runs is congested and narrow in certain locations. Navigating around utilities on the shoulder or within the roadway would be costly and time consuming.

g. Sustainability Considerations

This project reconstructs a gravity sewer system, so there are no long-term energy impacts. During construction, the extensive excavation, trenching, backfill, and surface restoration will consume much more energy than the other alternatives.

h. Cost Estimates

This is by far the most expensive option investigated in this analysis. In addition to the overall high cost of the piping, the excavation, traffic control, and bypass pumping, there is a high potential for construction problems and unforeseen conflicts that could drive the cost up significantly. The below is a unit cost breakout of an estimated open trench replacement cost for this project.

Collection System Refurbishment

Alternative 2: Open Trench Reconstruction

PLANNING LEVEL COST ESTIMATE

	DESCRIPTION OF ITEM	EST. QTY.	UNITS	UNIT PRICE	AMOUNT
1	Mobilization	1	LS	$850,000.00	$850,000.00
2	Clearing and Grubbing	1	AC	$25,000.00	$25,000.00
3	Trench Excavation & Backfill, 0-10 Ft Depth	22,300	LF	$55.00	$1,226,500.00
4	Pipe Bedding	22,300	LF	$10.00	$223,000.00
5	8-Inch PVC Sewer Main, D 3034, SDR 35	22,300	LF	$55.00	$1,226,500.00
6	Concrete Manhole, 48-Inch Diameter, 10' depth	110	EA	$6,800.00	$748,000.00
7	Service Line Trench Excavation & Backfill	33,500	LF	$45.00	$1,507,500.00
8	Service Line Bedding	33,500	LF	$6.00	$201,000.00
9	4-Inch PVC Sewer Service Pipe	33,500	LF	$12.00	$402,000.00
10	Asphalt Repair, 3-Inch Depth, 22-Foot width	56,222	SY	$45.00	$2,529,990.00
11	Crushed Surfacing Top Course, 4-Inch Depth	6,240	CY	$105.00	$655,200.00
12	Surface Restoration, Hydroseed	10	AC	$11,000.00	$110,000.00
13	Traffic Control	120	DAY	$1,500.00	$180,000.00
14	Trench Dewatering	120	DAY	$3,000.00	$360,000.00
15	Temporary Sewage Bypass Pumping	120	DAY	$2,500.00	$300,000.00
16	Spill Prevention, Control, and Countermeasures	1	LS	$20,000.00	$20,000.00
				CONSTRUCTION TOTAL	**$10,564,690.00**
				CONSTRUCTION CONTINGENCY, 25%	**$2,641,200.00**
				SALES TAX 8.5%	**$1,122,500.65**
				ENGINEERING DESIGN	**$1,716,800.00**
				CONSTRUCTION MANAGEMENT & INSPECTION	**$1,584,800.00**
				TOTAL ESTIMATED CAPITAL COST	**$17,630,000.00**

4B.3 Alternative 3 – Pipe Bursting

a. Description

Pipe bursting is a trenchless installation method, where a cutting head is pulled through the existing pipe to split it open, and new pipe is pulled along behind the cutting head. The existing manhole locations are used as receiving and sending pits. This replaces the sewer main between the manholes without trench excavation. However, excavation is still required at the manholes, and each side sewer must still be replaced by open trench excavation.

This option is more feasible than full open trenching or no action, but does still require the removal and replacement of all manholes along the stretch as well as the trench excavation to replace services at all locations. For these reasons this option is less desirable than the preferred option as it still leaves ample room for error in the relocation of utilities and the potential for construction issues at each excavation point.

This alternative has results similar to other scenarios in that a I&I will be reduced and a long-lived resilient asset is place. However, it still requires a significant amount of excavation and surface disruption.

b. Design Criteria

The new pipe installed by the pipe bursting method will be HDPE, which is more flexible than PVC. The diameter of the new pipe will be the same as the old pipe. The pipe will also be laid at the same grade, as it is essentially sleeved inside the old pipe.

All the old manholes along the replaced segments will be dug up and disposed, with new water-tight manholes installed after the pipe is installed.

c. Map

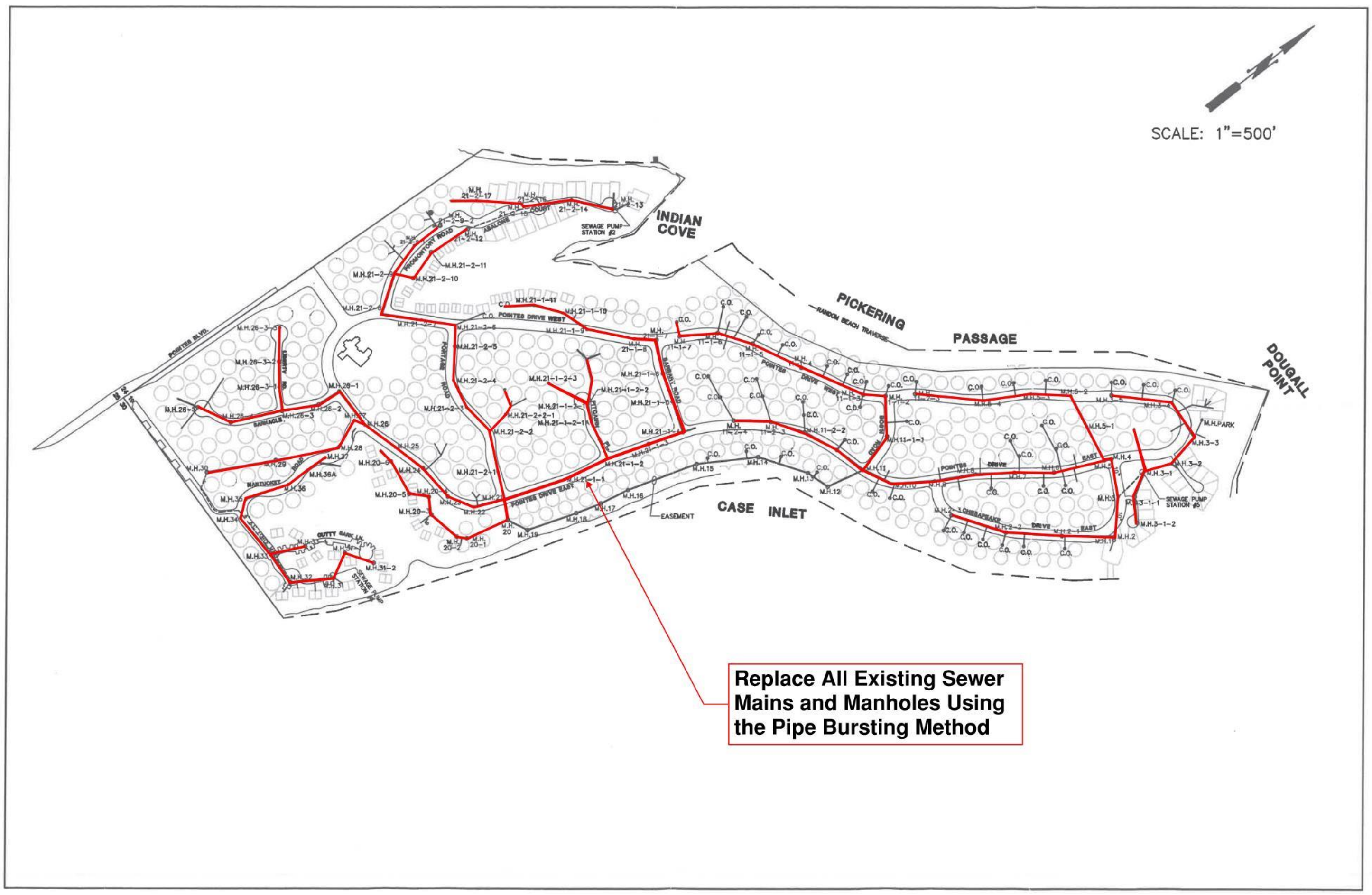


Figure 4-5: Alternative 3 Replacement by Pipe Bursting

d. Environmental Impacts

Even though pothole excavation is required at each manhole and service connection, the total disturbed area is much smaller than standard open trench construction. This results in reduced impacts to the environment, less stormwater to manage, and smaller areas of surface restoration.

e. Land Requirements

This alternative places pipe within the existing pipeline and stays within existing rights-of-way and easements, so no land acquisition is needed.

f. Potential Construction Problems

Pipe bursting is dependent on the existing soils having enough give that the old pipe can be split open, and the new pipe pulled through inside it. Some soil types are less suitable to this process. Also, the presence of large rocks too close to the pipe, or metal fittings that are sometimes used for repairs can cause problems with pipe bursting.

As this alternative places the new pipe inside of the old pipe, sewer service must be cut off for a time at the segment being worked on, and sewer flows upstream from the project must be bypass pumped around the project.

Although the amount of excavation is much less than conventional construction, reconnecting service lines and replacing manholes will require excavation, and the possibility of interference from other buried utilities.

g. Sustainability Considerations

This alternative results in a new gravity sewer pipe, and has no long-term energy demands. While under construction, the energy demands will be much lower then open-trench construction due to the reduced amount of excavation.

h. Cost Estimates

While this alternative is somewhat more affordable than open trenching this option is still more expensive than the preferred alternative. The requisite replacement of all manholes and trench excavation at each service connection make this option difficult to adopt.

Below is a cost estimate for the bursting alternative which is significantly less than open trench replacement.

Collection System Refurbishment

Alternative 3: Pipe Bursting

PLANNING LEVEL COST ESTIMATE

	DESCRIPTION OF ITEM	EST. QTY.	UNITS	UNIT PRICE	AMOUNT
1	Mobilization	1	LS	$650,000.00	$650,000.00
2	Clearing and Grubbing	1	AC	$25,000.00	$25,000.00
3	Pipeline Flushing & Inspection	22,300	LF	$8.00	$178,400.00
4	Pipe Bursting with 8-Inch HDPE Pipe	22,300	LF	$135.00	$3,010,500.00
5	Pulling Pit Excavation	110	EA	$1,100.00	$121,000.00
6	Concrete Manhole, 48-Inch Diameter, 10' depth	110	EA	$6,800.00	$748,000.00
7	Service Line Trench Excavation & Backfill	33,500	LF	$45.00	$1,507,500.00
8	Service Line Bedding	33,500	LF	$6.00	$201,000.00
9	4-Inch PVC Sewer Service Pipe	33,500	LF	$12.00	$402,000.00
10	Asphalt Repair, 3-Inch Depth, 16 SY patches	8,880	SY	$45.00	$399,600.00
11	Crushed Surfacing Top Course, 4-Inch Depth	1,000	CY	$105.00	$105,000.00
12	Surface Restoration, Hydroseed	10	AC	$11,000.00	$110,000.00
13	Traffic Control	120	DAY	$1,500.00	$180,000.00
14	Trench Dewatering	60	DAY	$500.00	$30,000.00
15	Temporary Sewage Bypass Pumping	120	DAY	$2,500.00	$300,000.00
16	Spill Prevention, Control, and Countermeasures	1	LS	$20,000.00	$20,000.00
				CONSTRUCTION TOTAL	**$7,988,000.00**
				CONSTRUCTION CONTINGENCY, 25%	**$1,997,000.00**
				SALES TAX 8.5%	**$848,725.00**
				ENGINEERING DESIGN	**$1,298,100.00**

CONSTRUCTION MANAGEMENT & INSPECTION	**$1,198,200.00**
TOTAL ESTIMATED CAPITAL COST	**$13,331,000.00**

4B.4 Alternative 4 – CIPP Lining

a. Description

This alternative utilizes the Cured-In-Place-Pipe (CIPP) lining process to restore the function of the existing sewer main. In this process, the existing pipe is used as a conduit for a flexible liner that is pulled through the pipe between manholes. The liner is expanded to the full diameter of the pipe, and then cured in place to form a liner that runs the full length of the pipe without joints. After curing, a remote cutter travels through the pipe and cuts openings in the pipe at each side sewer entrance. Each side sewer then receives a similar treatment with the liner pulled between a "T" liner at the main and a cleanout installed at each property line. The result is a fully lined pipe capable of lasting up to 50 years without any major ground disturbance and minimal service interruptions.

This option is highly feasible as it will provide minimal down time (lower cost of traffic control and bypass pumping), long service life (50 years), and a minimum of extraneous construction and environmental requirements.

b. Design Criteria

Due to the high groundwater that contributes to the excess I&I, the structural integrity of the CIPP liner must be considered. After the pipe is lined, the groundwater level may rise, as it no longer has an easy path to drainage. While the existing pipe has adequate strength to resist collapse from soil loads, the liner must be able to withstand the hydraulic pressure exerted by groundwater. Design tables by the CIPP Corporation indicate that an 8" diameter pipe lined with a 6 mm (0.263 inch) thick CIPP will withstand a groundwater load up to 40 feet of depth. The sewer pipes in Hartstene Pointe are not more than 10 to 12 feet deep, so the standard nominal thickness of 6mm is adequate for this installation.

c. <u>Map</u>

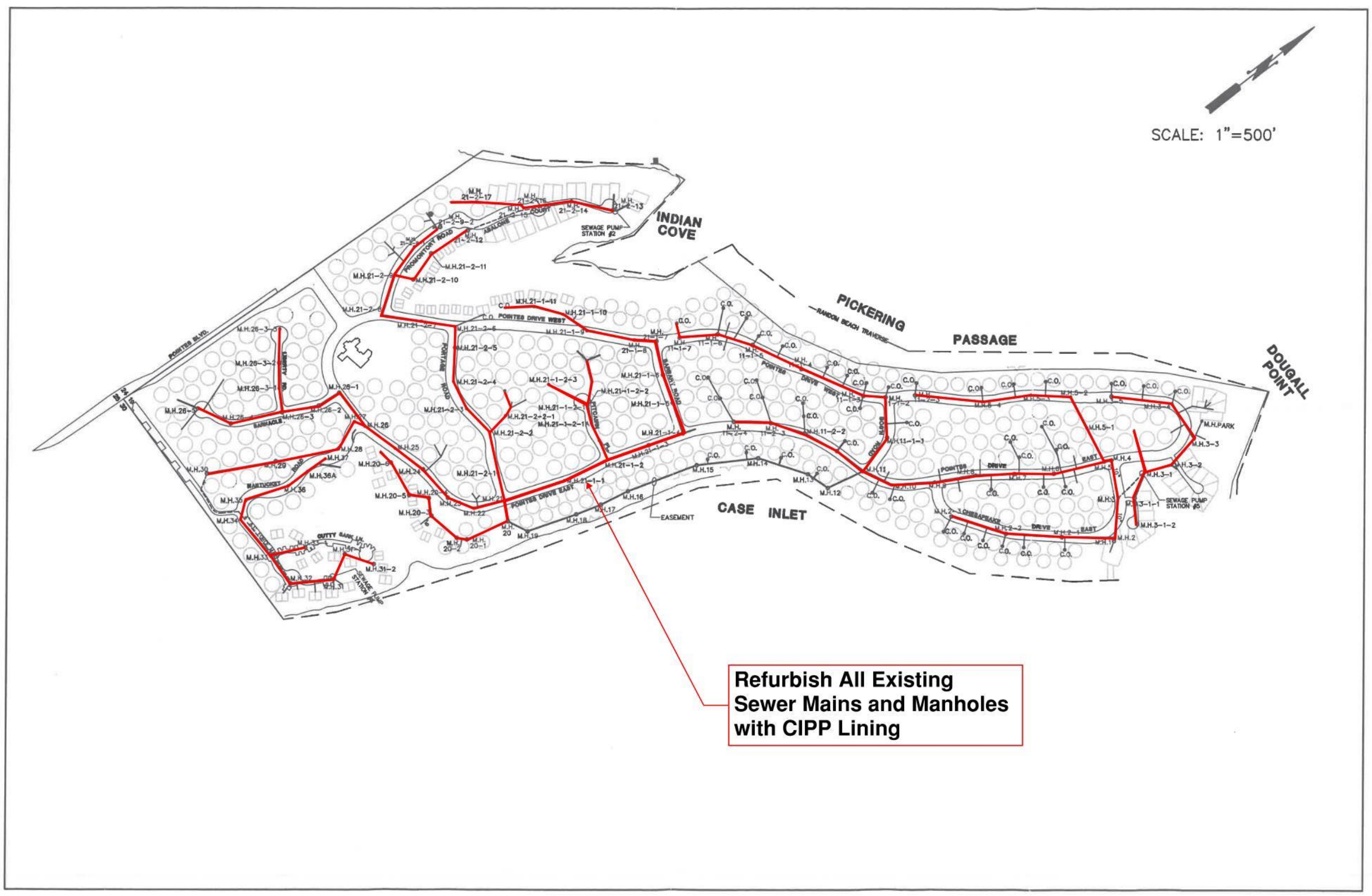


Figure 4-6: Alternative 4 Refurbishment by CIPP Lining

d. <u>Environmental Impacts</u>

This alternative does not require excavation except to install service line cleanouts, and requires minimal surface disturbance. This alternative has the lowest environmental impacts of the available options. Eliminating major ground disturbance also reduces environmental and section 106 reviews to a much lower level, simplifying the effort required for regulators, tribes, and interested parties.

e. Land Requirements

The CIPP liner stays within the existing pipe and manholes, so no land acquisition is required.

f. Potential Construction Problems

The CIPP process depends on the existing pipe being structurally sound and relatively straight, with no major breaks or offset joints. Previous video surveys of this system indicate that the pipes meet the requirements and are good candidates for the CIPP process.

The new pipe liner is placed inside of the old pipe, and so sewer service must be cut off for a time at the segment being worked on, and sewer flows upstream from the project must be bypass pumped around the project.

g. Sustainability Considerations

This alternative also results in a gravity sewer system with no operational energy requirements. This alternative has the lowest energy use during construction due to the absence of excavation.

h. Cost Estimates

CIPP lining represents a fraction of the construction and design cost of other methods of construction while delivering a comparable end product. By installing single liner socks from one existing manhole to the next and restoring services by robotic cutter technology, the District can maximize their existing infrastructure and service levels while still obtaining a beneficial end product.

As illustrated in the below cost estimate this alternative is by far the most cost effective.

Collection System Refurbishment

Alternative 4: Cured-in-Place-Pipe (CIPP) Lining

PLANNING LEVEL COST ESTIMATE

	DESCRIPTION OF ITEM	EST. QTY.	UNITS	UNIT PRICE	AMOUNT
1	Mobilization	1	LS	$620,000.00	$620,000.00
2	Pipeline Flushing & Inspection	22,500	LF	$8.00	$180,000.00
3	CIPP Lining	22,500	LF	$75.00	$1,687,500.00
4	Manhole Lining	110	EA	$1,500.00	$165,000.00
5	Service Line Cleanout	445	EA	$800.00	$356,000.00
6	Service Line T Liner	445	EA	$2,800.00	$1,246,000.00
7	Service Line CIPP Liner	33,500	LF	$95.00	$3,182,500.00
8	Traffic Control	120	DAY	$500.00	$60,000.00
9	Temporary Sewage Bypass Pumping	120	DAY	$2,500.00	$300,000.00
10	Spill Prevention, Control, and Countermeasures	1	LS	$20,000.00	$20,000.00
					$0.00
				CONSTRUCTION TOTAL	**$7,817,000.00**
				CONSTRUCTION CONTINGENCY, 25%	**$1,954,300.00**
				SALES TAX 8.5%	**$830,560.50**
				ENGINEERING DESIGN	**$1,074,900.00**
				CONSTRUCTION MANAGEMENT & INSPECTION	**$1,172,600.00**
				TOTAL ESTIMATED CAPITAL COST	**$12,850,000.00**

5. Recommended Alternative

PART A – BLUFF SEWER LINE REPLACEMENT

The alternatives to relocate the Bluff Sewer Line differ widely in both their capital costs and operating costs. To provide a fair evaluation, the life cycle costs should be considered. The Net Present Value as listed below provides the life cycle costs assuming a 20-year life cycle, including immediate capital costs as well as operating costs over the next 20 years.

Alternative	Capital Costs	Annual O&M Costs	Net Present Value
Alt 1: Gravity Sewer & Gravity Services	$ 3,011,000	$ 1,000	$ 3,030,586
Alt 2: Community Lift Station & Grouped Grinder Services	$ 1,896,000	$ 11,900	$ 2,129,074
Alt 3: Gravity Sewer & Grouped Grinder Services	$ 2,973,000	$ 8,600	$ 3,141,440

Alternative 2, Community Lift Station and Grouped Grinder Pump Services is lowest in cost, both for immediate capital expenses, and throughout the life cycle. Additionally, it has the lowest impacts to the environment, and less disruption to roads, trees, and services. This combination of lowest cost and lowest impacts make **Alternative 2, Community Lift Station and Grouped Grinder Pump Services** the preferred alternative for relocating the bluff sewer main.

PART B – I & I REDUCTION

Each of the alternatives would replace or refurbish the existing line along the same alignment. Each alternative will result in a gravity sewer system that will greatly reduce or eliminate I&I. The O&M expenses will be minimal and essentially the same for all the alternatives, so detailed O&M and life cycle cost analysis is unnecessary.

Based on the discussion and criteria explored in the analysis above, the clear recommendation is a CIPP liner installation for the full collection system. In addition to being the least expensive alternative, it also has the lowest impact to the environment, least disruption to traffic, and lowest potential for construction problems. For these reasons **Alternative 4 CIPP Lining** is recommended.

Alternative	Capital Costs	Environmental Impact	Service Disruption	Const. Problem Potential
Alt 1: Open Trench Construction	$ 17,630,000	High	High	High
Alt 2: Pipe Bursting	$ 13,331,000	Moderate	Moderate	Moderate
Alt 3: CIPP Lining	$ 12,850,000	Low	Low	Low

6. Funding Options and the Path Forward

The excessive I&I issues and potential for structural pipe failure has led the District to work with their on-call consulting engineer to develop a funding strategy and plan of action to address these conditions. Several funding options were considered including self-funding, Community Development Block Grants (CDBG), Department of Ecology, and USDA. Based on initial cost estimates, the option of self-funding is not feasible as the effect to rate payers would be unsustainable and existing reserves are inadequate. CDBG funding is not an option as the District is not eligible to receive funds per American Community Service data. Department of Ecology Funding may be possible; however, it would require completion of a full General Sewer Plan which would cost upwards of $75,000 and could take as much as a year to complete before a construction application could even be submitted. The elimination of these options leaves USDA-RD funding as the most feasible and available source.